PATENT ABSTRACTS OF JAPAN

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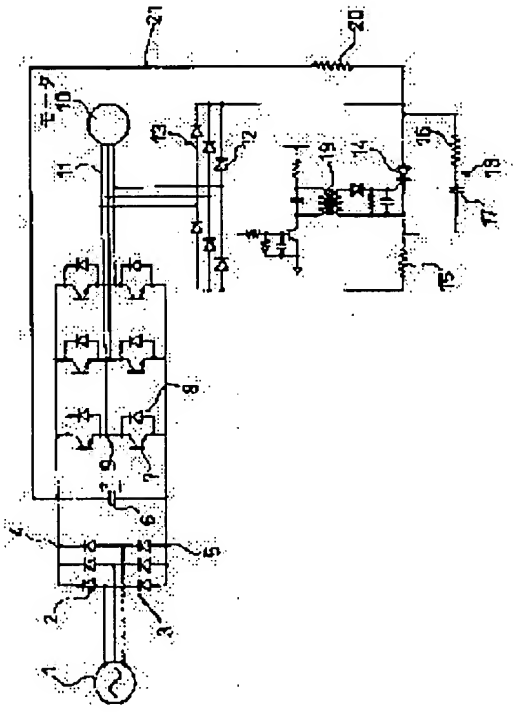
(54) DYNAMIC BRAKE CIRCUIT AND SEMICONDUCTOR INVERTER DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To prevent a voltage change dv/dt produced in an inverter from directly igniting a semiconductor brake switch mistakenly and short-circuiting the inverter which is in operation.

SOLUTION: When an inverter drive motor 10 which is driven by an AC power supply 1, a rectifying circuit 3, a smoothing capacitor 6 and an inverter unit 7 is braked, a dynamic brake circuit ignites a semiconductor brake switch 14 and short circuits the feeder lines of the motor 10 and makes a brake resistor 15 absorb energy. A resistor 20 of a high resistance is provided between the anode side of the smoothing capacitor 6 and the anode side of the semiconductor brake switch 14. A snubber capacitor 17 of a snubber circuit 18, connected in parallel to the semiconductor brake switch 14 is set so as to be charged via the resistor 20 of the high resistance before the inverter is operated.



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CLAIMS

[Claim(s)]
[Claim 1] The dynamic brake circuit characterized by having the charge circuit which precedes driving said load in the dynamic brake circuit which has the series-connection circuit of the resistance which changes the electrical energy of a load into heat, and a solid-state-switching component, and a snubber circuit containing the capacitor by which parallel connection is carried out to this solid-state-switching component, and charges said capacitor beforehand.
[Claim 2] The 1st rectification section which rectifies an alternating current, and the smooth section which carries out smooth [of the output of this 1st rectification section], The inverter section which switches the output of this smooth section by the 1st solid-state-switching component to desired timing, The 2nd rectification section which is semi-conductor inverter equipment which **** and rectifies the output of said inverter section further, The 1st resistance and the series connection circuit of the 2nd solid-state-switching component which are connected between the output terminals of this 2nd rectification section, In the inverter equipment which has the dynamic brake circuit which changes, and a snubber circuit containing the capacitor by which parallel connection is carried out to this 2nd solid-state-switching component since -- Semi-conductor inverter equipment characterized by having the charge circuit which charges said capacitor beforehand before said inverter section starts inverter actuation.
[Claim 3] Semi-conductor inverter equipment according to claim 2 with which said charge circuit is characterized by the 2nd resistance connected between the positive-electrode sides of said dynamic brake circuit the positive-electrode side of said smooth section, and being constituted by the 3rd switching element.
[Claim 4] Semi-conductor inverter equipment according to claim 3 characterized by making the one section of said 1st solid-state-switching component serve a double purpose instead of said 3rd switching element.
[Claim 5] Semi-conductor inverter equipment according to claim 2 characterized by making said fly wheel diode serve a double purpose instead of the diode which constitutes one arm of said 2nd rectification section in the inverter equipment according to claim 2 which has the fly wheel diode by which antiparallel connection was carried out to said 1st solid-state-switching component.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] This invention relates to malfunction prevention of the dynamic brake circuit of the motor driven with the inverter equipment which consisted of solid-state-switching components.
[0002]
[Description of the Prior Art] The method called the dynamic brake to which is made to suspend actuation of an inverter, short-circuits the power generated in the feeder of the motor which rotates by inertia with a breaking resistor, is made to consume as heat energy, is made to carry out energy absorption, and braking is applied in order to stop in an emergency the inverter drive motor represented by a permanent magnet type synchronous motor etc. is used. Drawing 5 is the circuit diagram of the brake gear of the conventional inverter drive motor. In drawing, the end of the smooth resistor 27 is connected to the positive electrode 26 of the output of a bridge circuit which connected six diodes 25 to three-phase-circuit AC power supply, and the smoothing capacitor 29 is connected between the other end of this smooth resistor 27, and the negative electrode 28 of the output of a bridge circuit. 3 sets of groups which carried out two-piece series connection of the solid-state-switching components 30, such as a transistor and a thyristor, to juxtaposition are connected in this smoothing capacitor 29. It connects with the feeder 32 of a motor 31, and the middle node of this solid-state-switching component 30 drives a motor 31 with the phase according to the switching timing of the solid-state-switching component 30. On the other hand, in order to apply braking to this motor 31, the series circuit of the thyristor 34 and breaking resistor 35 which are the three -phase-circuit bridge rectifier circuit of the diode 33 connected to the feeder 32 and a semi-conductor braking switch is prepared. The snubber circuit which carried out the series connection of the snubber resistor 36 and the snubber capacitor 37 is connected to this thyristor 34 and juxtaposition. In drawing, a bias capacitor and 41 are bias resistors and the photo coupler to which the current-limiting resistor for ignition and 39 change from a photodiode and a photo thyristor in 38, and 40 all constitute the ignition control circuit of a thyristor 34. If one photodiode of a photo coupler 39 is made to emit light while stopping the flow of the solid-state-switching component 30 and stopping the electric supply to a motor 31 and a photo thyristor is made to ignite in electric insulation, in order to carry out the emergency stop of the motor 31, since a signal will be impressed to the gate of a thyristor 34 in equipment such conventionally, a thyristor 34 ignites and flows. The electrical and electric equipment which was generated from the motor 31 by this and sent to the feeder 32 flows with diode 33, a thyristor 34, a breaking resistor 35, diode 33, and a feeder 32, and exoergic absorption is carried out with a breaking resistor 35. A motor 31 will be quickly braked by this. However, it set to equipment conventionally, in the switching operation of the solid-state-switching component 30 at the time of inverter operation, when electrical-potential-difference rate-of-change dv/dt was too large, the rise rate of critical off -state voltage of a thyristor might be exceeded, the break through of the photo thyristor and thyristor 34 of a photo coupler 39 might be carried out, and between inverter outputs (i.e., between feeders 32) might be connected with not requiring braking too hastily.
[0003]
[Problem(s) to be Solved by the Invention] As mentioned above, conventionally, according to equipment, big electrical-potential-difference change dv/dt might be produced by actuation of the solid -state-switching component of an inverter, the break through of the semi -conductor braking switch might be carried out by impression of the big electrical-potential-difference change dv/dt, and between inverter output lines might be short -circuited. In order to prevent this, capacity of a snubber circuit had to be made into sufficient thing to control electrical-potential-difference change dv/dt, and the sufficiently big semi-conductor braking switch of the rise rate of critical off -state voltage had to be chosen. For this reason, the circuit was enlarged and complicated and there was un -arranging [that components cost went up]. Then, this invention aims at offering the brake gear of the safe inverter drive motor with which electrical-

potential-difference change dv/dt produced by actuation of the solid-state-switching component of an inverter is not impressed to a direct semi-conductor braking switch.

[0004]

[Means for Solving the Problem] It is characterized by having the charge circuit which precedes driving said load and charges said capacitor beforehand in the dynamic brake circuit which has the series-connection circuit of the resistance which changes the electrical energy of a load into heat, and a solid-state-switching component, and a snubber circuit containing the capacitor by which parallel connection is carried out to this solid-state-switching component according to invention according to claim 1, in order to attain the above-mentioned purpose. Moreover, the 1st rectification section which rectifies an alternating current according to invention according to claim 2, The smooth section which carries out smooth [of the output of this 1st rectification section], and the inverter section which switches the output of this smooth section by the 1st solid-state-switching component to desired timing, The 2nd rectification section which is semi-conductor inverter equipment which **** and rectifies the output of said inverter section further, The 1st resistance and the series connection circuit of the 2nd solid-state-switching component which are connected between the output terminals of this 2nd rectification section, In the inverter equipment which has the dynamic brake circuit which changes, and a snubber circuit containing the capacitor by which parallel connection is carried out to this 2nd solid-state-switching component since -- Before said inverter section starts inverter actuation, it is characterized by having the charge circuit which charges said capacitor beforehand. Furthermore, according to invention according to claim 3, said charge circuit is characterized by the 2nd resistance connected between the positive-electrode sides of said dynamic brake circuit the positive-electrode side of said smooth section, and being constituted by the 3rd switching element. Moreover, according to invention according to claim 4, it is characterized by making the one section of said 1st solid-state-switching component serve a double purpose instead of said 3rd switching element. And according to invention according to claim 5, in the inverter equipment according to claim 2 which has the fly wheel diode by which antiparallel connection was carried out to said 1st solid-state-switching component, it is characterized by making said fly wheel diode serve a double purpose instead of the diode which constitutes one arm of said 2nd rectification section.

[0005]

[Embodiment of the Invention] Next, drawing 1 - drawing 4 explain the gestalt of implementation of this invention to a detail further. Each of drawing 1 - drawing 4 is the circuit diagrams showing the example which prepared the charge circuit which charges the snubber capacitor 17 of a snubber circuit 18. In drawing 1 , the positive electrode and negative electrode of a smoothing capacitor 6 are connected to the positive electrode 4 and negative electrode 5 of an output of a bridge circuit 3 which connected six diodes 2 to three-phase-circuit AC power supply 1. 3 sets of groups which carried out the two-piece series connection of the solid-state-switching components 7, such as a thyristor and a transistor, to this smoothing capacitor 6 at juxtaposition are connected, and the inverter section is formed. A fly wheel diode 8 is reverse-connected to each solid-state-switching component 7, respectively, the middle node 9 of the solid-state-switching component 7 is made with the outputting point of each phase, and the feeder 11 of each phase of a motor 10 is connected. Phase control etc. is made in the property [motor / 10] according to the switching timing of the solid-state-switching component 7. In order to apply braking to this motor 10, the dynamic brake circuit which carried out the series connection of the three-phase-circuit bridge circuit 13 of the diode 12 connected to the feeder 11, the thyristor 14 which is a semi-conductor braking switch, and the dynamic braking resistor 15 is prepared. Moreover, the snubber circuit 18 which carried out the series connection of the snubber resistor 16 and the snubber capacitor 17 to the thyristor 14 at juxtaposition is connected. The gate circuit which used the pulse transformer 19 is connected to the gate electrode of a thyristor 14. And between the positive-electrode sides of the positive-electrode side of a thyristor 14, and a smoothing capacitor 6, the charge circuit 21 which consists of a charge resistor 20 of high resistance by this invention is connected. What is necessary is just to ignite which solid-state-switching component 7 of the negative side arm of the inverter section in the above circuit, when charging the snubber capacitor 17 in advance of operation of the inverter section now. If it does so, the charge circuit which the negative electrode of the negative side arm diode -> feeder 11 -> solid-state-switching component 7 -> smoothing capacitor 6 of the snubber resistor 16 -> snubber capacitor 17 -> dynamic-braking-resistor 15 -> three-phase-circuit bridge circuit 13 of the charge resistor 20 -> snubber circuit 18 of the positive-electrode -> charge circuit 21 of a smoothing capacitor 6 closed will be formed, and charge of a smoothing capacitor 6 will be charged by the snubber capacitor 17. The electrical potential difference of the both ends of the snubber capacitor 17 after charge termination, i.e., the electrical potential difference of the both ends of a thyristor 14, becomes equal to the electrical potential difference of a smoothing capacitor 6. Charge time constant [in this case] tau (t) becomes a formula (1).

tau (t) = (R15+R16+R20) / C17 (1)

Thus, according to this invention, where rapid electrical-potential-difference rate-of-change dv/dt is controlled with the time constant of the big charge resistor 20 of resistance, and the snubber capacitor 17, the snubber capacitor 17 is charged. Since the same electrical potential difference as the smoothing capacitor 6 which is the input of the inverter section is already charged by the snubber capacitor 17 even if it starts inverter actuation after the snubber capacitor 17 is charged Since dv/dt by switching of the transistor which constitutes the inverter section is not impressed to the thyristor 14 which functions as a switch of a dynamic brake circuit at all, the break through of a thyristor 14 is prevented. Moreover, the need of using the thyristor 14 for carrying out break-through prevention as an object with a big dv/dt tolerated dose is also lost, and a snubber circuit 18 can also be simplified to what has a small capacity. Although the thyristor was used with the gestalt of operation of this invention as a switching element of a dynamic brake circuit, it may not be limited to a thyristor and a mechanical switch (for example, relay) may be used not to mention solid-state-switching components, such as a triac and a transistor. Furthermore, the approach pour the pulse transformer other than a photo coupler, and they pour a current to a ** relay coil is sufficient as the drive approaches, such as these solid-state-switching components. As long as the resistor on a charge circuit is in this circuit, it may be anywhere, and by the current control by the charge means, as long as the charging time can be adjusted, this resistor may not exist. Moreover, although it is made to make it serve a double purpose with the transistor (the 1st solid -state-switching component) of the inverter section as a switch for closing motion of a charge circuit with the gestalt of operation of this invention, of course, the 3rd switching element only for [a charge circuit] closing motion may be prepared outside independently.

[0006] Drawing 2 shows the example at the time of changing the gate circuit of the example shown in drawing 1 . In drawing 2 , the positive electrode and negative electrode of a smoothing capacitor 6 are connected to the positive electrode 4 and negative electrode 5 of an output of a bridge circuit 3 which connected six diodes 2 to three -phase-circuit AC power supply 1. 3 sets of groups which carried out the two -piece series connection of the solid-state-switching component 7 to this smoothing capacitor 6 at juxtaposition are connected, and the inverter section is formed. The flywheel diode 8 is connected to each solid-state-switching component 7, respectively, the middle node 9 of the solid-state-switching component 7 is made with the outputting point of each phase, and the feeder 11 of each phase of a motor 10 is connected. Phase control etc. is made in the property [motor / 10] according to the switching timing of the solid-state-switching component 7. In order to apply braking to this motor 10, the dynamic brake circuit which carried out the series connection of the three-phase-circuit bridge circuit 13, the thyristor 14, and dynamic braking resistor 15 of the diode 12 connected to the feeder 11 is prepared. The snubber circuit 18 which carried out the series connection of the snubber resistor 16 and the snubber capacitor 17 to the thyristor 14 at juxtaposition is connected. The gate circuit using the photo coupler 22 which consists of the pair of a photo transistor and a photo thyristor is connected to the gate electrode of a thyristor 14. The reason using a photo coupler 22 is for once transposing the signal by the side of a low-pressure ignition power source and a high-pressure thyristor to light, and performing electric insulation. And between the positive-electrode sides of the positive-electrode side of a thyristor 14, and a smoothing capacitor 6, the charge circuit 21 which consists of a charge resistor 20 of high resistance concerning this invention is connected. By this, the snubber capacitor 17 is always beforehand charged at the time of actuation of the inverter section. What is necessary is just to ignite which solid-state-switching component 7 of the negative side arm of the inverter section in the above circuit, when charging the snubber capacitor 17 in advance of operation of the inverter section now. If it does so, the charge circuit which the negative electrode of the negative side arm diode -> feeder 11 -> solid-state-switching component 7 -> smoothing capacitor 6 of the snubber resistor 16 -> snubber capacitor 17 -> dynamic-braking-resistor 15 -> three-phase-circuit bridge circuit 13 of the charge resistor 20 -> snubber circuit 18 of the positive-electrode - > charge circuit 21 of a smoothing capacitor 6 closed will be formed, and charge of a smoothing capacitor 6 will be charged by the snubber capacitor 17. The electrical potential difference of the both ends of the snubber capacitor 17 after charge termination, i.e., the electrical potential difference of the both ends of a thyristor 14, becomes equal to the electrical potential difference of a smoothing capacitor 6. Thus, according to constituted this invention, where rapid electrical-potential-difference rate-of-change dv/dt is controlled with the time constant of the big charge resistor 20 of resistance, and the snubber capacitor 17, the snubber capacitor 17 is charged. Since the same electrical potential difference as the smoothing capacitor 6 which is the input of the inverter section is already charged by the snubber capacitor 17 even if it starts inverter actuation after the snubber capacitor 17 is charged Since dv/dt by switching of the transistor which constitutes the inverter section is not impressed to the thyristor 14 and photo thyristor 22 which function as a switch of a dynamic brake circuit at all, the break through of a thyristor 14 and a photo thyristor 22 is prevented. Moreover, the need of using the thyristor 14 and photo thyristor 22 for carrying out break-through prevention as an object with a big dv/dt tolerated dose is also lost, and a snubber circuit 18 can also be simplified to

what has a small capacity.

[0007] Drawing 3 shows the circuit of the gestalt which shared the component of a dynamic -braking circuit, and the component of the energy-absorbing circuit of a motor feeder. In drawing 3 , the positive electrode and negative electrode of a smoothing capacitor 6 are connected to the positive electrode 4 and negative electrode 5 of an output of a bridge circuit 3 which connected six diodes 2 to three-phase-circuit AC power supply 1. Connect 3 sets of groups which carried out the two-piece series connection of the solid-state-switching components 7, such as a transistor, to this smoothing capacitor 6 at juxtaposition, and the inverter section is formed. About the point of reverse -connecting the flywheel diode 8 to each solid-state-switching component 7, respectively, making the middle node 9 of the solid -state-switching component 7 into the outputting point of each phase, and connecting the feeder 11 of each phase of a motor 10, it is the same as the case of drawing 1 and drawing 2 . The charge resistor 20 by which an end is connected to the positive-electrode side of a smoothing capacitor 6 in the case of this example, The thyristor 14 by which a positive -electrode side is connected to the other end of this charge resistor 20, The breaking resistor 15 by which an end is connected to the cathode side of this thyristor 14, A positive-electrode side is connected to the other end of this breaking resistor 15, it has three diodes 23 by which a cathode side is connected to the feeder 11 of each phase of said motor, and the gate circuit which used the pulse transformer 19 is connected to the gate electrode of a thyristor 14. In this circuit when a motor 10 needs to be braked If the gate circuit of a thyristor 14 is made to turn on after stopping ignition of the solid-state-switching component 7 of the inverter section and suspending inverter actuation, since a thyristor 14 will flow, The circuit of the feeder 11 -> middle node 9 -> flywheel diode 8 -> charge resistor 20 -> thyristor 14 -> breaking resistor 15 -> diode 23 -> feeder 11 is formed, a breaking resistor 15 generates heat, energy absorption is carried out and brakes are applied to a motor 10. Thus, according to the gestalt of this operation, since the flywheel diode 8 of the 1st solid-state-switching component 7 of a positive-electrode side arm was made to substitute for the diode group 12 of the positive-electrode side arm of the 2nd rectification section 13 of drawing 1 , it will contribute to a miniaturization and low cost-ization. While the snubber capacitor 17 is always charged and this circuit also controls dv/dt of the inverter section through the charge resistor 20 as said explanation, in order that diode 23 may prevent direct penetration of dv/dt from the inverter section, it stops moreover, producing the defect short circuit by the dynamic brake circuit during inverter actuation.

[0008] Drawing 4 is replaced with the circuit which used the pulse transformer 19 as a gate circuit of the thyristor 14 of the circuit of drawing 3 , the example using the photo coupler 22 which consists of a photodiode and a photo thyristor is shown, since others are the same, the same sign is given to the same part and explanation is omitted.

[0009]

[Effect of the Invention] According to this invention, at as mentioned above, the time of braking of the inverter drive motor driven with the switching output of a current which rectified the alternating current and carried out smooth with the smoothing capacitor To the brake gear of the inverter drive motor which ignites a semi -conductor braking switch, short-circuits between the feeders of said motor, and absorbs energy with a dynamic braking resistor By having prepared the charge circuit which always charges a snubber capacitor between the positive -electrode sides of a semi-conductor braking switch the positive-electrode side of a smoothing capacitor It is lost that electrical-potential-difference change dv/dt of the inverter section is impressed to a semi-conductor braking switch, and malfunction of a semi-conductor braking switch can be prevented. Therefore, a snubber circuit can be simplified, and since components with a low dv/dt tolerated dose can be used, price reduction of equipment can be aimed at.

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MEANS

[Means for Solving the Problem] It is characterized by having the charge circuit which precedes driving said load and charges said capacitor beforehand in the dynamic brake circuit which has the series-connection circuit of the resistance which changes the electrical energy of a load into heat, and a solid-state-switching component, and a snubber circuit containing the capacitor by which parallel connection is carried out to this solid-state-switching component according to invention according to claim 1, in order to attain the above-mentioned purpose. Moreover, the 1st rectification section which rectifies an alternating current according to invention according to claim 2, The smooth section which carries out smooth [of the output of this 1st rectification section], and the inverter section which switches the output of this smooth section by the 1st solid-state-switching component to desired timing, The 2nd rectification section which is semi-conductor inverter equipment which **** and rectifies the output of said inverter section further, The 1st resistance and the series connection circuit of the 2nd solid-state-switching component which are connected between the output terminals of this 2nd rectification section, In the inverter equipment which has the dynamic brake circuit which changes, and a snubber circuit containing the capacitor by which parallel connection is carried out to this 2nd solid-state-switching component since -- Before said inverter section starts inverter actuation, it is characterized by having the charge circuit which charges said capacitor beforehand. Furthermore, according to invention according to claim 3, said charge circuit is characterized by the 2nd resistance connected between the positive-electrode sides of said dynamic brake circuit the positive-electrode side of said smooth section, and being constituted by the 3rd switching element. Moreover, according to invention according to claim 4, it is characterized by making the one section of said 1st solid-state-switching component serve a double purpose instead of said 3rd switching element. And according to invention according to claim 5, in the inverter equipment according to claim 2 which has the fly wheel diode by which antiparallel connection was carried out to said 1st solid-state-switching component, it is characterized by making said fly wheel diode serve a double purpose instead of the diode which constitutes one arm of said 2nd rectification section.
[0005]
[Embodiment of the Invention] Next, drawing 1 - drawing 4 explain the gestalt of implementation of this invention to a detail further. Each of drawing 1 - drawing 4 is the circuit diagrams showing the example which prepared the charge circuit which charges the snubber capacitor 17 of a snubber circuit 18. In drawing 1 , the positive electrode and negative electrode of a smoothing capacitor 6 are connected to the positive electrode 4 and negative electrode 5 of an output of a bridge circuit 3 which connected six diodes 2 to three-phase-circuit AC power supply 1. 3 sets of groups which carried out the two-piece series connection of the solid-state-switching components 7, such as a thyristor and a transistor, to this smoothing capacitor 6 at juxtaposition are connected, and the inverter section is formed. A fly wheel diode 8 is reverse-connected to each solid-state-switching component 7, respectively, the middle node 9 of the solid-state-switching component 7 is made with the outputting point of each phase, and the feeder 11 of each phase of a motor 10 is connected. Phase control etc. is made in the property [motor / 10] according to the switching timing of the solid-state-switching component 7. In order to apply braking to this motor 10, the dynamic brake circuit which carried out the series connection of the three-phase-circuit bridge circuit 13 of the diode 12 connected to the feeder 11, the thyristor 14 which is a semi-conductor braking switch, and the dynamic braking resistor 15 is prepared. Moreover, the snubber circuit 18 which carried out the series connection of the snubber resistor 16 and the snubber capacitor 17 to the thyristor 14 at juxtaposition is connected. The gate circuit which used the pulse transformer 19 is connected to the gate electrode of a thyristor 14. And between the positive-electrode sides of the positive-electrode side of a thyristor 14, and a smoothing capacitor 6, the charge circuit 21 which consists of a charge resistor 20 of high resistance by this invention is connected. What is necessary is just to ignite which solid-state-switching component 7 of the negative side arm of the inverter section in the above circuit, when charging the snubber capacitor 17 in advance of operation of the inverter section now. If it does so, the charge circuit which the negative electrode of the negative side arm diode -> feeder 11 - >

solid-state-switching component 7 -> smoothing capacitor 6 of the snubber resistor 16 -> snubber capacitor 17 -> dynamic-braking-resistor 15 -> three-phase-circuit bridge circuit 13 of the charge resistor 20 -> snubber circuit 18 of the positive-electrode -> charge circuit 21 of a smoothing capacitor 6 closed will be formed, and charge of a smoothing capacitor 6 will be charged by the snubber capacitor 17. The electrical potential difference of the both ends of the snubber capacitor 17 after charge termination, i.e., the electrical potential difference of the both ends of a thyristor 14, becomes equal to the electrical potential difference of a smoothing capacitor 6. Charge time constant [in this case] tau (t) becomes a formula (1).

tau (t) = (R15+R16+R20) / C17 (1)

Thus, according to this invention, where rapid electrical-potential-difference rate-of-change dv/dt is controlled with the time constant of the big charge resistor 20 of resistance, and the snubber capacitor 17, the snubber capacitor 17 is charged. Since the same electrical potential difference as the smoothing capacitor 6 which is the input of the inverter section is already charged by the snubber capacitor 17 even if it starts inverter actuation after the snubber capacitor 17 is charged Since dv/dt by switching of the transistor which constitutes the inverter section is not impressed to the thyristor 14 which functions as a switch of a dynamic brake circuit at all, the break through of a thyristor 14 is prevented. Moreover, the need of using the thyristor 14 for carrying out break-through prevention as an object with a big dv/dt tolerated dose is also lost, and a snubber circuit 18 can also be simplified to what has a small capacity.

Although the thyristor was used with the gestalt of operation of this invention as a switching element of a dynamic brake circuit, it may not be limited to a thyristor and a mechanical switch (for example, relay) may be used not to mention solid-state-switching components, such as a triac and a transistor. Furthermore, the approach pour the pulse transformer other than a photo coupler, and they pour a current to a ** relay coil is sufficient as the drive approaches, such as these solid-state-switching components. As long as the resistor on a charge circuit is in this circuit, it may be anywhere, and by the current control by the charge means, as long as the charging time can be adjusted, this resistor may not exist. Moreover, although it is made to make it serve a double purpose with the transistor (the 1st solid -state-switching component) of the inverter section as a switch for closing motion of a charge circuit with the gestalt of operation of this invention, of course, the 3rd switching element only for [a charge circuit] closing motion may be prepared outside independently.

[0006] Drawing 2 shows the example at the time of changing the gate circuit of the example shown in drawing 1 . In drawing 2 , the positive electrode and negative electrode of a smoothing capacitor 6 are connected to the positive electrode 4 and negative electrode 5 of an output of a bridge circuit 3 which connected six diodes 2 to three -phase-circuit AC power supply 1. 3 sets of groups which carried out the two -piece series connection of the solid-state-switching component 7 to this smoothing capacitor 6 at juxtaposition are connected, and the inverter section is formed. The flywheel diode 8 is connected to each solid-state-switching component 7, respectively, the middle node 9 of the solid-state-switching component 7 is made with the outputting point of each phase, and the feeder 11 of each phase of a motor 10 is connected. Phase control etc. is made in the property [motor / 10] according to the switching timing of the solid-state-switching component 7. In order to apply braking to this motor 10, the dynamic brake circuit which carried out the series connection of the three-phase-circuit bridge circuit 13, the thyristor 14, and dynamic braking resistor 15 of the diode 12 connected to the feeder 11 is prepared. The snubber circuit 18 which carried out the series connection of the snubber resistor 16 and the snubber capacitor 17 to the thyristor 14 at juxtaposition is connected. The gate circuit using the photo coupler 22 which consists of the pair of a photo transistor and a photo thyristor is connected to the gate electrode of a thyristor 14. The reason using a photo coupler 22 is for once transposing the signal by the side of a low-pressure ignition power source and a high-pressure thyristor to light, and performing electric insulation. And between the positive-electrode sides of the positive-electrode side of a thyristor 14, and a smoothing capacitor 6, the charge circuit 21 which consists of a charge resistor 20 of high resistance concerning this invention is connected. By this, the snubber capacitor 17 is always beforehand charged at the time of actuation of the inverter section. What is necessary is just to ignite which solid-state-switching component 7 of the negative side arm of the inverter section in the above circuit, when charging the snubber capacitor 17 in advance of operation of the inverter section now. If it does so, the charge circuit which the negative electrode of the negative side arm diode -> feeder 11 -> solid-state-switching component 7 -> smoothing capacitor 6 of the snubber resistor 16 -> snubber capacitor 17 -> dynamic-braking-resistor 15 -> three-phase-circuit bridge circuit 13 of the charge resistor 20 -> snubber circuit 18 of the positive-electrode -> charge circuit 21 of a smoothing capacitor 6 closed will be formed, and charge of a smoothing capacitor 6 will be charged by the snubber capacitor 17. The electrical potential difference of the both ends of the snubber capacitor 17 after charge termination, i.e., the electrical potential difference of the both ends of a thyristor 14, becomes equal to the electrical potential difference of a smoothing capacitor 6. Thus, according to constituted this invention, where rapid

electrical-potential-difference rate-of-change dv/dt is controlled with the time constant of the big charge resistor 20 of resistance, and the snubber capacitor 17, the snubber capacitor 17 is charged. Since the same electrical potential difference as the smoothing capacitor 6 which is the input of the inverter section is already charged by the snubber capacitor 17 even if it starts inverter actuation after the snubber capacitor 17 is charged Since dv/dt by switching of the transistor which constitutes the inverter section is not impressed to the thyristor 14 and photo thyristor 22 which function as a switch of a dynamic brake circuit at all, the break through of a thyristor 14 and a photo thyristor 22 is prevented. Moreover, the need of using the thyristor 14 and photo thyristor 22 for carrying out break-through prevention as an object with a big dv/dt tolerated dose is also lost, and a snubber circuit 18 can also be simplified to what has a small capacity.

[0007] Drawing 3 shows the circuit of the gestalt which shared the component of a dynamic -braking circuit, and the component of the energy-absorbing circuit of a motor feeder. In drawing 3 , the positive electrode and negative electrode of a smoothing capacitor 6 are connected to the positive electrode 4 and negative electrode 5 of an output of a bridge circuit 3 which connected six diodes 2 to three-phase-circuit AC power supply 1. Connect 3 sets of groups which carried out the two-piece series connection of the solid-state-switching components 7, such as a transistor, to this smoothing capacitor 6 at juxtaposition, and the inverter section is formed. About the point of reverse -connecting the flywheel diode 8 to each solid-state-switching component 7, respectively, making the middle node 9 of the solid -state-switching component 7 into the outputting point of each phase, and connecting the feeder 11 of each phase of a motor 10, it is the same as the case of drawing 1 and drawing 2 . The charge resistor 20 by which an end is connected to the positive-electrode side of a smoothing capacitor 6 in the case of this example, The thyristor 14 by which a positive -electrode side is connected to the other end of this charge resistor 20, The breaking resistor 15 by which an end is connected to the cathode side of this thyristor 14, A positive-electrode side is connected to the other end of this breaking resistor 15, it has three diodes 23 by which a cathode side is connected to the feeder 11 of each phase of said motor, and the gate circuit which used the pulse transformer 19 is connected to the gate electrode of a thyristor 14. In this circuit when a motor 10 needs to be braked If the gate circuit of a thyristor 14 is made to turn on after stopping ignition of the solid-state-switching component 7 of the inverter section and suspending inverter actuation, since a thyristor 14 will flow, The circuit of the feeder 11 -> middle node 9 -> flywheel diode 8 -> charge resistor 20 -> thyristor 14 -> breaking resistor 15 -> diode 23 -> feeder 11 is formed, a breaking resistor 15 generates heat, energy absorption is carried out and brakes are applied to a motor 10. Thus, according to the gestalt of this operation, since the flywheel diode 8 of the 1st solid-state-switching component 7 of a positive-electrode side arm was made to substitute for the diode group 12 of the positive-electrode side arm of the 2nd rectification section 13 of drawing 1 , it will contribute to a miniaturization and low cost-ization. While the snubber capacitor 17 is always charged and this circuit also controls dv/dt of the inverter section through the charge resistor 20 as said explanation, in order that diode 23 may prevent direct penetration of dv/dt from the inverter section, it stops moreover, producing the defect short circuit by the dynamic brake circuit during inverter actuation.

[0008] Drawing 4 is replaced with the circuit which used the pulse transformer 19 as a gate circuit of the thyristor 14 of the circuit of drawing 3 , the example using the photo coupler 22 which consists of a photodiode and a photo thyristor is shown, since others are the same, the same sign is given to the same part and explanation is omitted.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] It is the circuit diagram showing the gestalt of 1 operation of the semi-conductor inverter equipment with a dynamic brake circuit by this invention.
[Drawing 2] Drawing 1 is drawing showing the semi-conductor inverter equipment which has a different thyristor gate circuit.
[Drawing 3] It is the circuit diagram showing the modification of drawing 1 .
[Drawing 4] It is the circuit diagram showing the modification of drawing 2 .
[Drawing 5] It is the circuit diagram of equipment conventionally.
[Description of Notations]
1 Three-Phase-Circuit AC Power Supply
2, 12, 23 Diode
3 Three-Phase-Circuit Bridge Circuit
4 Positive Electrode of Output of Three-Phase-Circuit Bridge Circuit
5 Negative Electrode of Output of Three-Phase-Circuit Bridge Circuit
6 Smoothing Capacitor
7 Solid-State-Switching Component (Power Transistor)
8 Fly Wheel Diode
9 Middle Node
10 Motor
11 Feeder
13 Three-Phase-Circuit Bridge Circuit
14 Semi-conductor Braking Switch (Thyristor)
15 Breaking Resistor
16 Snubber Resistor
17 Snubber Capacitor
18 Snubber Circuit
19 Pulse Transformer
20 Charge Resistor
21 Charge Circuit
22 Photo Coupler Which Consists of Photodiode and Photo Thyristor

[Translation done.]

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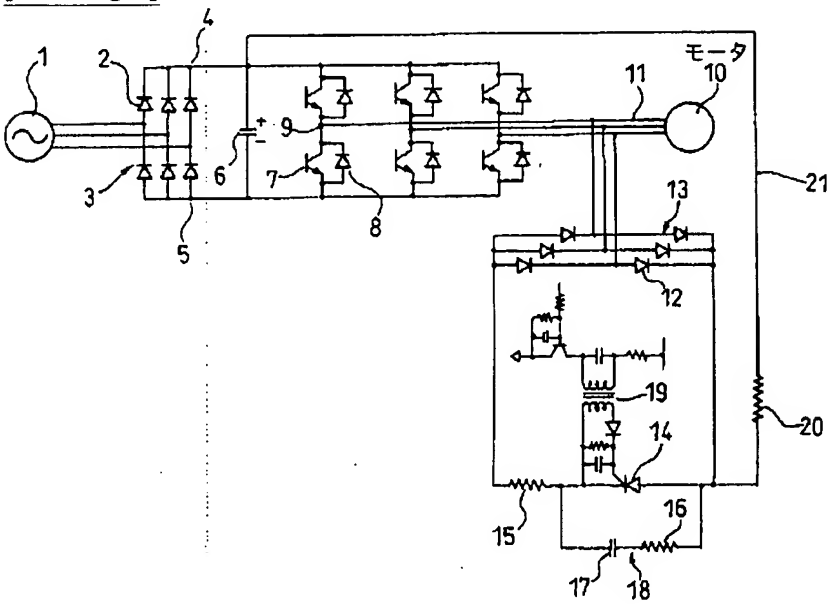
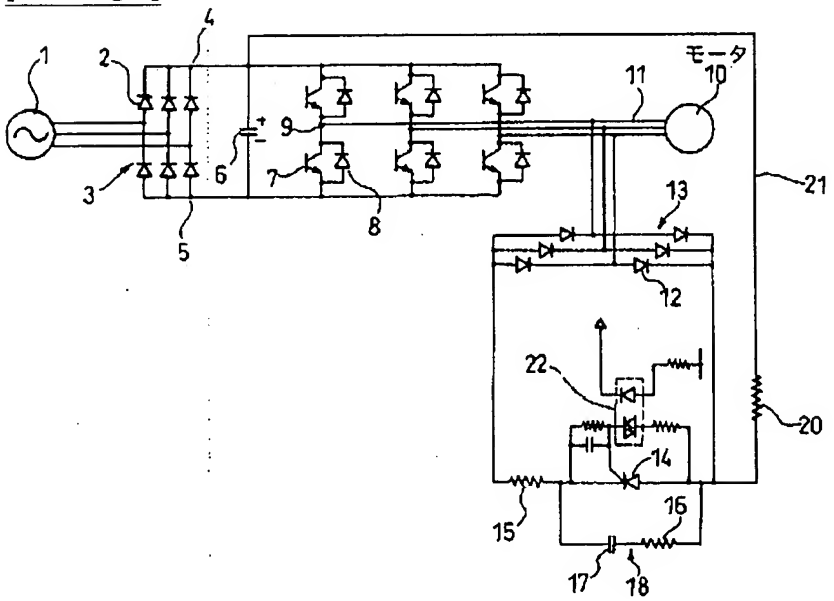
DRAWINGS

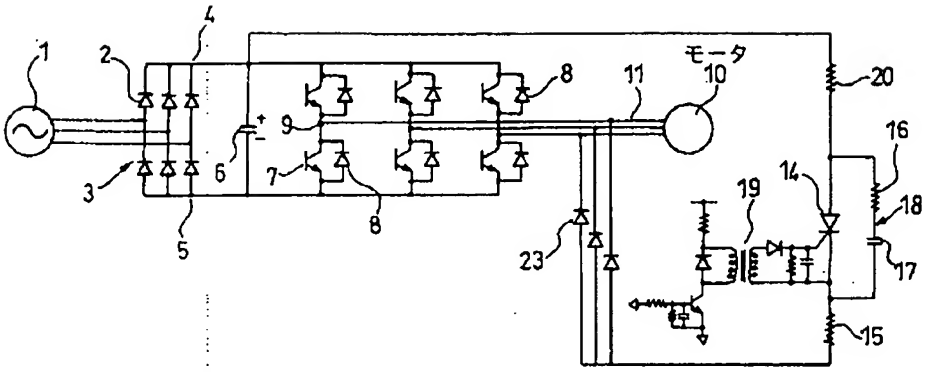
[Drawing 1]



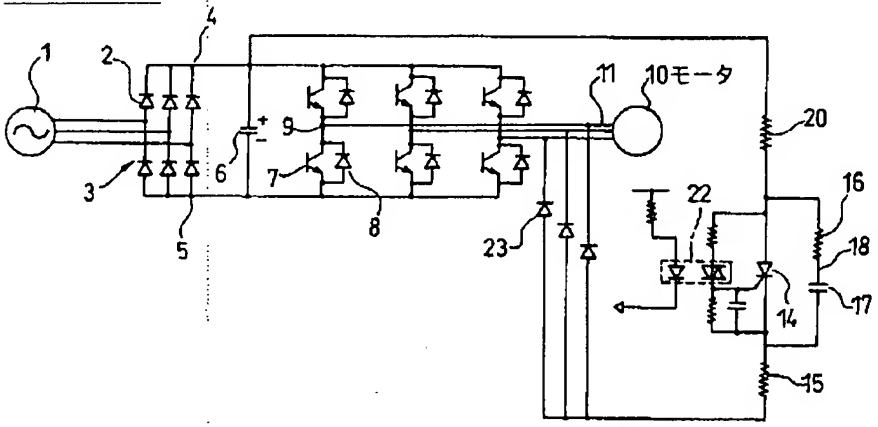
[Drawing 2]



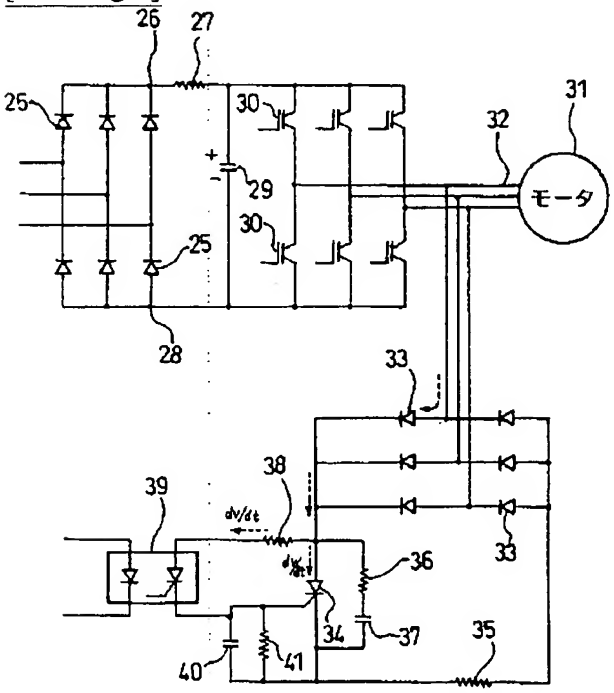
[Drawing 3]



[Drawing 4]



[Drawing 5]



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TECHNICAL FIELD

[Field of the Invention] This invention relates to malfunction prevention of the dynamic brake circuit of the motor driven with the inverter equipment which consisted of solid-state-switching components.

[Translation done.]

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PRIOR ART

[Description of the Prior Art] The method called the dynamic brake to which is made to suspend actuation of an inverter, short-circuits the power generated in the feeder of the motor which rotates by inertia with a breaking resistor, is made to consume as heat energy, is made to carry out energy absorption, and braking is applied in order to stop in an emergency the inverter drive motor represented by a permanent magnet type synchronous motor etc. is used. Drawing 5 is the circuit diagram of the brake gear of the conventional inverter drive motor. In drawing, the end of the smooth resistor 27 is connected to the positive electrode 26 of the output of a bridge circuit which connected six diodes 25 to three-phase-circuit AC power supply, and the smoothing capacitor 29 is connected between the other end of this smooth resistor 27, and the negative electrode 28 of the output of a bridge circuit. 3 sets of groups which carried out two-piece series connection of the solid-state-switching components 30, such as a transistor and a thyristor, to juxtaposition are connected in this smoothing capacitor 29. It connects with the feeder 32 of a motor 31, and the middle node of this solid-state-switching component 30 drives a motor 31 with the phase according to the switching timing of the solid-state-switching component 30. On the other hand, in order to apply braking to this motor 31, the series circuit of the thyristor 34 and breaking resistor 35 which are the three -phase-circuit bridge rectifier circuit of the diode 33 connected to the feeder 32 and a semi-conductor braking switch is prepared. The snubber circuit which carried out the series connection of the snubber resistor 36 and the snubber capacitor 37 is connected to this thyristor 34 and juxtaposition. In drawing, a bias capacitor and 41 are bias resistors and the photo coupler to which the current-limiting resistor for ignition and 39 change from a photodiode and a photo thyristor in 38, and 40 all constitute the ignition control circuit of a thyristor 34. If one photodiode of a photo coupler 39 is made to emit light while stopping the flow of the solid-state-switching component 30 and stopping the electric supply to a motor 31 and a photo thyristor is made to ignite in electric insulation, in order to carry out the emergency stop of the motor 31, since a signal will be impressed to the gate of a thyristor 34 in equipment such conventionally, a thyristor 34 ignites and flows. The electrical and electric equipment which was generated from the motor 31 by this and sent to the feeder 32 flows with diode 33, a thyristor 34, a breaking resistor 35, diode 33, and a feeder 32, and exoergic absorption is carried out with a breaking resistor 35. A motor 31 will be quickly braked by this. However, it set to equipment conventionally, in the switching operation of the solid-state-switching component 30 at the time of inverter operation, when electrical-potential-difference rate-of-change dv/dt was too large, the rise rate of critical off-state voltage of a thyristor might be exceeded, the break through of the photo thyristor and thyristor 34 of a photo coupler 39 might be carried out, and between inverter outputs (i.e., between feeders 32) might be connected with not requiring braking too hastily.

[Translation done.]

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EFFECT OF THE INVENTION

[Effect of the Invention] As mentioned above, in this invention, the charge circuit which always charges a snubber capacitor between the positive-electrode sides of a semi-conductor braking switch was established in the brake gear of the inverter drive motor which ignites a semi-conductor braking switch, short-circuits between the feeders of said motor, and absorbs energy with a dynamic braking resistor at the time of braking of the inverter drive motor driven with the switching output of a current which rectified the alternating current and carried out smooth with the smoothing capacitor the positive-electrode side of a smoothing capacitor. Therefore, it is lost that electrical -potential-difference change dv/dt of the inverter section is impressed to a semi-conductor braking switch, and malfunction of a semi-conductor braking switch can be prevented. Therefore, a snubber circuit can be simplified, and since components with a low dv/dt tolerated dose can be used, price reduction of equipment can be aimed at.

[Translation done.]

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TECHNICAL PROBLEM

[Problem(s) to be Solved by the Invention] As mentioned above, conventionally, according to equipment, big electrical-potential-difference change dv/dt might be produced by actuation of the solid-state-switching component of an inverter, the break through of the semi-conductor braking switch might be carried out by impression of the big electrical-potential-difference change dv/dt, and between inverter output lines might be short-circuited. In order to prevent this, capacity of a snubber circuit had to be made into sufficient thing to control electrical-potential-difference change dv/dt, and the sufficiently big semi-conductor braking switch of the rise rate of critical off-state voltage had to be chosen. For this reason, the circuit was enlarged and complicated and there was un-arranging [that components cost went up]. Then, this invention aims at offering the brake gear of the safe inverter drive motor with which electrical-potential-difference change dv/dt produced by actuation of the solid-state-switching component of an inverter is not impressed to a direct semi-conductor braking switch.

[Translation done.]

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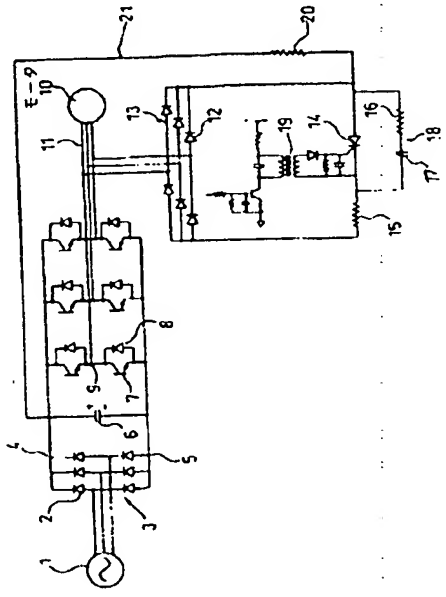
DD04 DD13 DD15 DD16 DD19
EE01

(54)【発明の名称】　ダイナミックブレーキ回路と半導体インバータ装置

(57)【要約】
【課題】　インバータで生ずる電圧変化ｄｖ／ｄｔが直接半導体制動スイッチを誤点弧させ、運転中のインバータを短絡することがあったのを防止する。
【解決手段】　交流１・整流３・平滑６・インバータ部７の諸回路によって駆動されるインバータ駆動モータ１０を制動する時に、半導体制動スイッチ１４を点弧して前記モータ１０の給電線間を短絡して制動抵抗器１５によってエネルギーを吸収するダイナミックブレーキ回路において、平滑コンデンサ６の正極側と半導体制動スイッチ１４の正極側との間に高抵抗器２０を配置し、半導体制動スイッチ１４と並列接続されているスナバ回路１８のスナバコンデンサ１７をインバータ運転前にこの高抵抗器２０を介して充電しておくようにした。



【特許請求の範囲】
【請求項１】　負荷の電気エネルギーを熱に変換する抵抗と半導体スイッチング素子との直列接続回路と、
該半導体スイッチング素子に並列接続されるコンデンサを含むスナバ回路と、を有するダイナミックブレーキ回路において、
前記負荷を駆動するに先立って前記コンデンサにあらかじめ充電する充電回路を備えたことを特徴とするダイナミックブレーキ回路。
【請求項２】　交流を整流する第１整流部と、該第１整流部の出力を平滑する平滑部と、該平滑部の出力を所望のタイミングで第１半導体スイッチング素子によってスイッチングするインバータ部と、を有する半導体インバータ装置であって、さらに、
前記インバータ部の出力を整流する第２整流部と、該第２整流部の出力端子間に接続される第１抵抗と第２半導体スイッチング素子の直列接続回路と、から成るダイナミックブレーキ回路と、
該第２半導体スイッチング素子に並列接続されるコンデンサを含むスナバ回路と、
を有するインバータ装置において、
前記インバータ部がインバータ動作を開始する前に前記コンデンサにあらかじめ充電する充電回路を備えたことを特徴とする半導体インバータ装置。
【請求項３】　前記充電回路が、前記平滑部の正極側と前記ダイナミックブレーキ回路の正極側との間に接続された第２抵抗と、第３のスイッチング素子によって構成されることを特徴とする請求項２記載の半導体インバータ装置。
【請求項４】　前記第３のスイッチング素子の代わりに、前記第１半導体スイッチング素子の１部を兼用することを特徴とする請求項３記載の半導体インバータ装置。
【請求項５】　前記第１半導体スイッチング素子と逆並列接続されたフライホイールダイオードを有する請求項２記載のインバータ装置において、
前記第２整流部の一方のアームを構成するダイオードの代わりに、前記フライホイールダイオードを兼用することを特徴とする請求項２記載の半導体インバータ装置。

【発明の詳細な説明】
【０００１】
【発明の属する技術分野】この発明は、半導体スイッチング素子で構成されたインバータ装置によって駆動されるモータのダイナミックブレーキ回路の誤動作防止に関する。
【０００２】
【従来の技術】永久磁石式同期電動機等によって代表されるインバータ駆動モータを非常時に停止させるためには、インバータの動作を停止させ、慣性で回転するモータの給電線に発生する電力を制動抵抗器で短絡して熱エネルギーとして消費させ、エネルギー吸収させて制動をかけるダイナミックブレーキ等と称される方式が用いられている。図５は、従来のインバータ駆動モータのブレーキ装置の回路図である。図において、６個のダイオード２５を３相交流電源に接続したブリッジ回路の出力の正極２６には平滑抵抗器２７の一端が接続され、この平滑抵抗器２７の他端とブリッジ回路の出力の負極２８との間には平滑コンデンサ２９が接続されている。この平滑コンデンサ２９とは並列に、トランジスタやサイリスタ等の半導体スイッチング素子３０を２個直列接続した組が３組接続されている。この半導体スイッチング素子３０の中間接続点は、モータ３１の給電線３２に接続され、モータ３１は半導体スイッチング素子３０のスイッチングタイミングに応じた位相で駆動される。一方、このモータ３１に制動をかけるため、給電線３２に接続されたダイオード３３の３相ブリッジ整流回路と半導体制動スイッチであるサイリスタ３４と制動抵抗器３５との直列回路が設けられている。スナバ抵抗器３６とスナバコンデンサ３７を直列接続したスナバ回路がこのサイリスタ３４と並列に接続されている。図において、３８は点弧用限流抵抗器、３９はフォトダイオードとフォトサイリスタから成るフォトカプラー、４０はバイアスコンデンサ、４１はバイアス抵抗器で、いずれもサイリスタ３４の点弧制御回路を構成している。このような従来装置において、モータ３１を非常停止させるためには、例えば半導体スイッチング素子３０の導通を停止させてモータ３１への給電を停止すると共に、フォトカプラー３９の一方のフォトダイオードを発光させてフォトサイリスタを電気絶縁的に点弧させれば、サイリスタ３４のゲートに信号が印加されるため、サイリスタ３４が点弧し導通する。これによって、モータ３１から発電されて給電線３２に送られた電気は、ダイオード３３、サイリスタ３４、制動抵抗器３５、ダイオード３３、給電線３２と流れ、制動抵抗器３５で発熱吸収される。これによってモータ３１は急速に制動されることとなる。しかしながら、従来装置においては、インバータ運転時における半導体スイッチング素子３０のスイッチング動作において、電圧変化率ｄｖ／ｄｔがあまりに大きいとサイリスタの臨界オフ電圧上昇率を超えてしまい、フォトカプラー３９のフォトサイリスタやサイリスタ３４を誤点弧させてしまい、制動を要求しないのにインバータ出力間を、すなわち、給電線３２間を短絡してしまうことがあった。
【０００３】
【発明が解決しようとする課題】上記のように、従来装置によれば、インバータの半導体スイッチング素子の動作によって大きな電圧変化ｄｖ／ｄｔを生じてしまい、その大きな電圧変化ｄｖ／ｄｔの印加によって半導体制動スイッチを誤点弧してしまい、インバータ出力線間を短絡してしまうことがあった。これを防ぐためには、ス

ナバ回路の容量を電圧変化ｄｖ／ｄｔを抑制するに十分なものとしたり、臨界オフ電圧上昇率の十分大きな半導体制動スイッチを選択しなければならなかった。このため、回路が大型化・複雑化し、部品コストが上昇したりするという不都合があった。そこでこの発明は、インバータの半導体スイッチング素子の動作によって生ずる電圧変化ｄｖ／ｄｔが直接半導体制動スイッチに印加されることの無い安全なインバータ駆動モータのブレーキ装置を提供することを目的とする。

【０００４】

【課題を解決するための手段】上記の目的を達成するため、請求項１記載の発明によれば、負荷の電気エネルギーを熱に変換する抵抗と半導体スイッチング素子との直列接続回路と、該半導体スイッチング素子に並列接続されるコンデンサを含むスナバ回路と、を有するダイナミックブレーキ回路において、前記負荷を駆動するに先立って前記コンデンサにあらかじめ充電する充電回路を備えたことを特徴としている。また、請求項２記載の発明によれば、交流を整流する第１整流部と、該第１整流部の出力を平滑する平滑部と、該平滑部の出力を所望のタイミングで第１半導体スイッチング素子によってスイッチングするインバータ部と、を有する半導体インバータ装置であって、さらに、前記インバータ部の出力を整流する第２整流部と、該第２整流部の出力端子間に接続される第１抵抗と第２半導体スイッチング素子の直列接続回路と、から成るダイナミックブレーキ回路と、該第２半導体スイッチング素子に並列接続されるコンデンサを含むスナバ回路と、を有するインバータ装置において、前記インバータ部がインバータ動作を開始する前に前記コンデンサにあらかじめ充電する充電回路を備えたことを特徴としている。さらに、請求項３記載の発明によれば、前記充電回路が、前記平滑部の正極側と前記ダイナミックブレーキ回路の正極側との間に接続された第２抵抗と、第３のスイッチング素子によって構成されることを特徴としている。また、請求項４記載の発明によれば、前記第３のスイッチング素子の代わりに、前記第１半導体スイッチング素子の１部を兼用することを特徴としている。そして、請求項５記載の発明によれば、前記第１半導体スイッチング素子と逆並列接続されたフライホイールダイオードを有する請求項２記載のインバータ装置において、前記第２整流部の一方のアームを構成するダイオードの代わりに、前記フライホイールダイオードを兼用することを特徴としている。

【０００５】

【発明の実施の形態】次に、図１～図４によってこの発明の実施の形態を更に詳細に説明する。図１～図４は、いずれもスナバ回路１８のスナバコンデンサ１７を充電する充電回路を設けた例を示す回路図である。図１において、３相交流電源１に６個のダイオード２を接続したブリッジ回路３の出力の正極４と負極５には平滑コンデンサ６の正極と負極とが接続されている。この平滑コンデンサ６と並列にサイリスタ、トランジスタ等の半導体スイッチング素子７を２個直列接続した組を３組接続してインバータ部を形成する。各半導体スイッチング素子７にはそれぞれフライホイールダイオード８が逆接続され、半導体スイッチング素子７の中間接続点９は各相の出力点となされ、モータ１０の各相の給電線１１が接続されている。モータ１０は半導体スイッチング素子７のスイッチングタイミングに応じた特性で位相制御等がなされる。このモータ１０に制動をかけるため、給電線１１に接続されたダイオード１２の３相ブリッジ回路１３と半導体制動スイッチであるサイリスタ１４と制動抵抗器１５とを直列接続したダイナミックブレーキ回路が設けられている。また、サイリスタ１４と並列にスナバ抵抗器１６とスナバコンデンサ１７を直列接続したスナバ回路１８が接続されている。サイリスタ１４のゲート電極には、パルストランス１９を用いた点弧回路が接続されている。そして、サイリスタ１４の正極側と平滑コンデンサ６の正極側との間には、本発明による高抵抗値の充電抵抗器２０からなる充電回路２１が接続されている。以上の回路において、いま、インバータ部の運転に先立ってスナバコンデンサ１７を充電する場合は、インバータ部の負側アームの何れかの半導体スイッチング素子７を点弧すればよい。そうすると、平滑コンデンサ６の正極→充電回路２１の充電抵抗器２０→スナバ回路１８のスナバ抵抗器１６→スナバコンデンサ１７→制動抵抗器１５→３相ブリッジ回路１３の負側アームダイオード→給電線１１→半導体スイッチング素子７→平滑コンデンサ６の負極の閉じた充電回路が形成され、平滑コンデンサ６のチャージがスナバコンデンサ１７に充電される。充電終了後のスナバコンデンサ１７の両端の電圧、すなわち、サイリスタ１４の両端の電圧は、平滑コンデンサ６の電圧と等しくなる。この場合の充電時定数τ（ｔ）は式（１）となる。

$$\tau(t) = (R15 + R16 + R20) / C17 \qquad (1)$$

このように、本発明によれば、抵抗値の大きな充電抵抗器２０とスナバコンデンサ１７の時定数で急激な電圧変化率ｄｖ／ｄｔが抑制された状態でスナバコンデンサ１７が充電され、スナバコンデンサ１７が充電された後に、インバータ動作を開始しても、インバータ部の入力である平滑コンデンサ６と同じ電圧がすでにスナバコンデンサ１７には充電されているので、インバータ部を構成するトランジスタのスイッチングによるｄｖ／ｄｔがダイナミックブレーキ回路のスイッチとして機能するサイリスタ１４に全く印加されないので、サイリスタ１４の誤点弧が阻止される。また、誤点弧防止するためのサイリスタ１４をｄｖ／ｄｔ耐量の大きな物とする必要も無くなり、またスナバ回路１８も容量の小さなものに簡略化できる。ダイナミックブレーキ回路のスイッチング

素子として、本発明の実施の形態ではサイリスタを用いたが、サイリスタに限定されるものではなく、トライアック、トランジスタ等の半導体スイッチング素子はもちろんのこと、機械的スイッチ（例えば、リレー）でもよい。さらに、これらの半導体スイッチング素子等のドライブ方法はフォトカプラーの他に、パルストランス、やリレーコイルに電流を流す方法でもよい。充電回路上の抵抗器はこの回路内であればどこにあってもよく、また、充電手段による電流制御によって充電時間が調節可能であれば、この抵抗器は無くてもよい。また、本発明の実施の形態では充電回路の開閉用スイッチとして、インバータ部のトランジスタ（第１半導体スイッチング素子）で兼用させているが、もちろん充電回路の開閉専用の第３のスイッチング素子を別に外部に設けてもよい。

【０００６】図２は、図１に示す例の点弧回路を変更した場合の例を示している。図２において、３相交流電源１に６個のダイオード２を接続したブリッジ回路３の出力の正極４と負極５には平滑コンデンサ６の正極と負極とが接続されている。この平滑コンデンサ６と並列に半導体スイッチング素子７を２個直列接続した組を３組接続してインバータ部を形成する。各半導体スイッチング素子７にはそれぞれフライホイルダイオード８が接続され、半導体スイッチング素子７の中間接続点９は各相の出力点となされ、モータ１０の各相の給電線１１が接続されている。モータ１０は半導体スイッチング素子７のスイッチングタイミングに応じた特性で位相制御等がなされる。このモータ１０に制動をかけるためには、給電線１１に接続されたダイオード１２の３相ブリッジ回路１３とサイリスタ１４と制動抵抗器１５とを直列接続したダイナミックブレーキ回路が設けられている。サイリスタ１４と並列にスナバ抵抗器１６とスナバコンデンサ１７を直列接続したスナバ回路１８が接続されている。サイリスタ１４のゲート電極には、フォトトランジスタとフォトサイリスタの対から成るフォトカプラー２２を用いた点弧回路が接続されている。フォトカプラー２２を用いる理由は、低圧の点弧電源側と高圧のサイリスタ側との信号をいったん光に置き換えて電気絶縁を行なうためである。そして、サイリスタ１４の正極側と平滑コンデンサ６の正極側との間には、本発明に係る高抵抗値の充電抵抗器２０からなる充電回路２１が接続されている。これによって、インバータ部の動作時には前もってスナバコンデンサ１７を常時充電しておくようにしている。以上の回路において、いま、インバータ部の運転に先立ってスナバコンデンサ１７を充電する場合は、インバータ部の負側アームの何れかの半導体スイッチング素子７を点弧すればよい。そうすると、平滑コンデンサ６の正極→充電回路２１の充電抵抗器２０→スナバ回路１８のスナバ抵抗器１６→スナバコンデンサ１７→制動抵抗器１５→３相ブリッジ回路１３の負側アームダイオード→給電線１１→半導体スイッチング素子７→平滑コンデンサ６の負極の閉じた充電回路が形成され、平滑コンデンサ６のチャージがスナバコンデンサ１７に充電される。充電終了後のスナバコンデンサ１７の両端の電圧、すなわち、サイリスタ１４の両端の電圧は、平滑コンデンサ６の電圧と等しくなる。このように構成された本発明によれば、抵抗値の大きな充電抵抗器２０とスナバコンデンサ１７の時定数で急激な電圧変化率ｄｖ／ｄｔが抑制された状態でスナバコンデンサ１７が充電され、スナバコンデンサ１７が充電された後に、インバータ動作を開始しても、インバータ部の入力である平滑コンデンサ６と同じ電圧がすでにスナバコンデンサ１７には充電されているので、インバータ部を構成するトランジスタのスイッチングによるｄｖ／ｄｔがダイナミックブレーキ回路のスイッチとして機能するサイリスタ１４およびフォトサイリスタ２２にまったく印加されないので、サイリスタ１４とフォトサイリスタ２２の誤点弧が阻止される。また、誤点弧防止するためのサイリスタ１４およびフォトサイリスタ２２をｄｖ／ｄｔ耐量の大きな物とする必要も無くなり、またスナバ回路１８も容量の小さなものに簡略化できる。

【０００７】図３は、発電制動回路の素子とモータ給電線のエネルギー吸収回路の素子とを共用した形態の回路を示している。図３において、３相交流電源１に６個のダイオード２を接続したブリッジ回路３の出力の正極４と負極５には平滑コンデンサ６の正極と負極とを接続し、この平滑コンデンサ６と並列にトランジスタ等の半導体スイッチング素子７を２個直列接続した組を３組接続してインバータ部を形成し、各半導体スイッチング素子７にはそれぞれフライホイルダイオード８を逆接続し、半導体スイッチング素子７の中間接続点９は各相の出力点とし、モータ１０の各相の給電線１１を接続する点については、図１、図２の場合と同じである。この例の場合、平滑コンデンサ６の正極側に一端が接続される充電抵抗器２０と、この充電抵抗器２０の他端に正極側が接続されるサイリスタ１４と、このサイリスタ１４の陰極側に一端が接続される制動抵抗器１５と、この制動抵抗器１５の他端に正極側が接続されて陰極側が前記モータの各相の給電線１１に接続される３個のダイオード２３とを備え、サイリスタ１４のゲート電極にはパルストランス１９を用いた点弧回路が接続されている。この回路において、モータ１０の制動が必要な場合は、インバータ部の半導体スイッチング素子７の点弧を中止してインバータ動作を停止した後にサイリスタ１４の点弧回路をオンさせると、サイリスタ１４が導通するため、給電線１１→中間接続点９→フライホイルダイオード８→充電抵抗器２０→サイリスタ１４→制動抵抗器１５→ダイオード２３→給電線１１の回路が形成され、制動抵抗器１５が発熱してエネルギー吸収し、モータ１０にブレーキがかかる。このように、本実施の形態によれば、図１の第２の整流部１３の正極側アームのダイオード群１

２を正極側アームの第１の半導体スイッチング素子７のフライホイルダイオード８で代用させたので、小型化・低コスト化に寄与することとなる。また、この回路も前記説明のとおり、充電抵抗器２０を介してスナバコンデンサ１７が常に充電されて、インバータ部のｄｖ／ｄｔを抑制すると共に、ダイオード２３がインバータ部からのｄｖ／ｄｔの直接進入を阻止するため、インバータ動作中にダイナミックブレーキ回路による不良短絡は生じなくなる。

【０００８】図４は、図３の回路のサイリスタ１４の点弧回路として、パルストランス１９を用いた回路に代えて、フォトダイオードとフォトサイリスタとから成るフォトカプラー２２を用いた例を示し、その他は同一であるので、同一部分に同一符号を付して説明は省略する。

【０００９】

【発明の効果】以上のように、本発明によれば、交流を整流して平滑コンデンサで平滑した電流のスイッチング出力によって駆動されるインバータ駆動モータの制動時に、半導体制動スイッチを点弧して前記モータの給電線間を短絡して制動抵抗器によってエネルギーを吸収するインバータ駆動モータのブレーキ装置に、平滑コンデンサの正極側と半導体制動スイッチの正極側との間にスナバコンデンサを常時充電する充電回路を設けたことにより、インバータ部の電圧変化ｄｖ／ｄｔが半導体制動スイッチに印加されることが無くなり、半導体制動スイッチの誤動作を防止することができる。したがって、スナバ回路を簡略化でき、ｄｖ／ｄｔ耐量の低い部品を使用することができるので装置の価格低減が図れる。

【図面の簡単な説明】

【図１】本発明によるダイナミックブレーキ回路付き半導体インバータ装置の１実施の形態を示す回路図である。

【図２】図１とは異なるサイリスタ点弧回路を有する半導体インバータ装置を示す図である。

【図３】図１の変形例を示す回路図である。

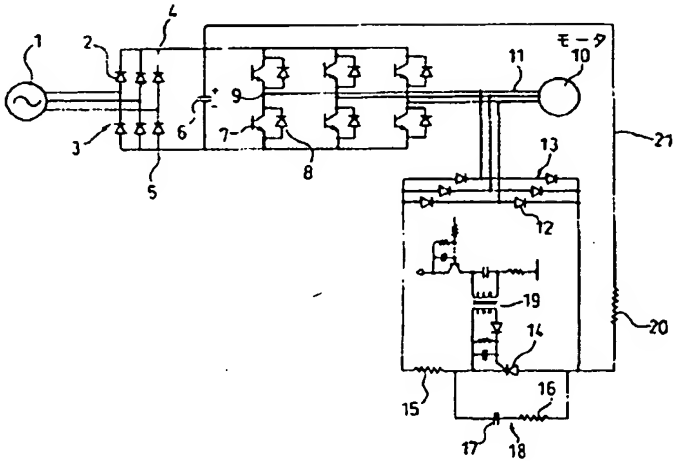
【図４】図２の変形例を示す回路図である。

【図５】従来装置の回路図である。

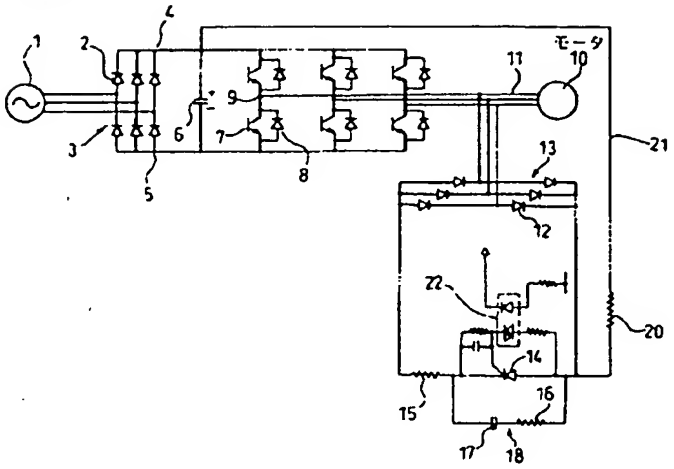
【符号の説明】

１　３相交流電源
２、１２、２３　ダイオード
３　３相ブリッジ回路
４　３相ブリッジ回路の出力の正極
５　３相ブリッジ回路の出力の負極
６　平滑コンデンサ
７　半導体スイッチング素子（パワートランジスタ）
８　フライホイールダイオード
９　中間接続点
１０　モータ
１１　給電線
１３　３相ブリッジ回路
１４　半導体制動スイッチ（サイリスタ）
１５　制動抵抗器
１６　スナバ抵抗器
１７　スナバコンデンサ
１８　スナバ回路
１９　パルストランス
２０　充電抵抗器
２１　充電回路
２２　フォトダイオードとフォトサイリスタから成るフォトカプラー

【図１】



【図２】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モータ
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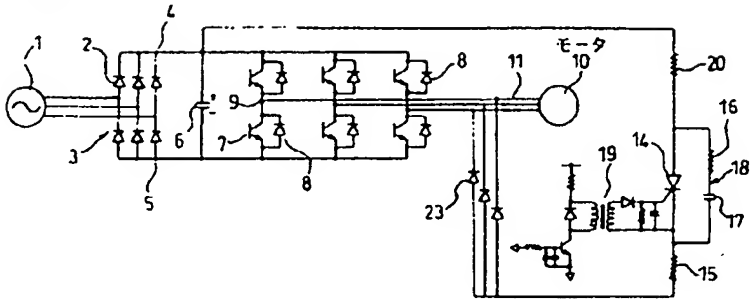
【図３】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モータ
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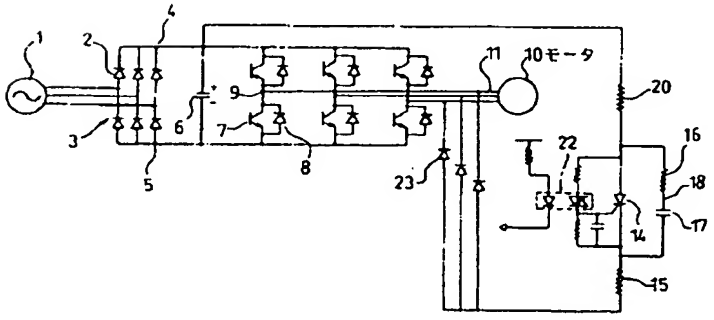
【図４】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【図５】